

**A Statistical-Distributed Hydrologic Model for Flash Flood Forecasting**  
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To meet the National Oceanic and Atmospheric Administration (NOAA) objective to increase lead-time and accuracy of flash flood forecasts, the NOAA National Weather Service (NWS) Office of Hydrologic Development (OHD) is testing the use of distributed hydrologic models. The benefits of distributed hydrologic models are being evaluated through research and prototype operational applications with several applications in mind, including flash flood, river flood, and water resource forecasts. In addition to the work described here, some ongoing NWS activities include prototype distributed model testing at two NWS River Forecast Centers, the Distributed Model Intercomparison Project, prototype conterminous U.S. model runs in OHD, collaborative parameter estimation research with the University of Arizona, and software engineering activities to integrate distributed modeling capabilities into the NWS River Forecast System (NWSRFS) as part of the Community Hydrologic Prediction System (CHPS) development effort.

Unlike lumped river models, distributed hydrologic models can run at the spatial and temporal scales necessary to model flash floods. However, hydrologic model errors tend to increase with decreasing basin sizes, and the scales at which we can benefit from running high resolution hydrologic models are not well known. We propose a statistical-distributed model for flood forecasting at ungauged locations and hypothesize that this model can outperform the current lumped model-based NWS Flash Flood Guidance (FFG) procedures. The statistical component of the model is a post-processor that converts high resolution grids of maximum forecast flood flow to grids of frequency. Frequency grids provide a well-understood historical context for characterizing flood severity. Frequency-based flood warning thresholds in a region can be defined based on local knowledge of flood stage frequency or local engineering design criteria for storm water structures such as culverts and detention ponds. In the proposed approach, flood frequencies in each grid cell are computed based on cell-specific historical simulation statistics. Our results show that use of simulation-based frequency values provides an implicit bias correction.

Results from model validation experiments on ten basins in Oklahoma and Arkansas, USA, ranging in size from 40 – 2500 km<sup>2</sup> will be presented (five of these basins are flash flood scale basins, < 260 km<sup>2</sup>). Simulations generated using the OHD Hydrology Laboratory's Research Distributed Hydrologic Model (HL-RDHM) with the statistical-distributed post-processor were analyzed. These experiments utilize eight years of 1-hour, 4-km multisensor (gauge and radar) Quantitative Precipitation Estimates (QPE). Results show improvement over current, lumped model-based FFG procedures. Further tests on even smaller basins are planned. A proposed operations concept and other needs for future work will be discussed.